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TITLE: VOICE SOUND TRANSMISSION APPARATUS, SYSTEM AND
METHOD INCLUDING CRADLE

CROSS REFERENCE TO RELATED APPLICATION

Continuation-In-Part of U.S. Patent Application Serial No. 09/587,743 filed June 5, 2000 entitled BONE CONDUCTION VOICE TRANSMISSION APPARATUS AND SYSTEM which is a continuation of U.S. Patent Application Serial No. 09/309,107 filed May 10, 1999 entitled BONE CONDUCTION VOICE TRANSMISSION APPARATUS AND SYSTEM, now issued as U.S. Patent No. 6,094,492.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to a voice sound transmitting and receiving apparatus and system. More particularly, though not exclusively, the present invention relates to a voice sound transmitting unit which is capable of connecting to a multitude of host devices through the use of a linked cradle.

PROBLEMS IN THE ART

Voice sound transmitting and receiving devices are known in the art. However, such devices are limited by the quality of voice even though they are capable of capturing and transmitting. For example, prior art microphones tend to pick up ambient noise and transmit the same. This is particularly problematic in communications applications that require a pure, unadulterated voice signal. For communication systems to more effectively utilize voice sound as a means of transmitting information, the prior art voice sound transmitting and receiving devices must be capable of producing a much purer voice sound signal. One specific communication application area that relies upon a clear voice signal is voice recognition technology.

Today, voice recognition software engines are gaining popularity. Such computer software enables the user to, among other things, enter information into a digital record or file directly through speech, obviating the need for a keyboard or other input device. Further, more and more hardware applications are providing for voice automated control. For example, currently many cellular telephones allow a user to simply voice in dialing commands. While voicing in commands and voicing in data have improved the efficiency of many applications, many problems still exist.

A problem that must be overcome to effectively implement an information or communication system using voice sound is the relatively poor quality of the voice sound signal currently obtained through prior art voice sound transmitting and receiving devices. Advocacy of voice recognition software engines depends upon the quality of the voice quality received. Bone conduction sensors deliver a fairly pure signal. Air conduction sensors, on the other hand, will receive a much stronger signal. Depending upon the application, one or more, or a combination of these sensors may be desirable.

Further, prior art voice sound transmitting and receiving devices block a substantial portion of the user's external auditory canal when in use. For example, prior voice sound transmitting devices, such as those disclosed in patent numbers 5,295,193 and 4,150,262 to Ono are designed with earpieces that totally obstruct the external auditory canal. Not only are such devices uncomfortable for the user to wear, but they also block external sound vibrations from entering the auditory canal. Further, such devices are less aesthetically pleasing to the user. There is therefore a need in the art for an improved voice sound transmitting unit that does not occlude the external auditory canal, is comfortable to wear for extended periods of time, and is aesthetically pleasing to the user.

Additionally, many host devices provide for input from voice sound transmitting and receiving devices. However,

often such inputs are mere headphone jacks, serial ports, parallel ports, or other types of connectors. These connectors or inputs fail to provide any type of wireless linkage between the host device and a voice sound transmitting and receiving device. There is therefore a need to provide a connecting device which is capable of connecting with current host devices and provides all of the necessary hardware to operatively link the voice sound transmitting and receiving device with the host device.

Finally, many host devices have undesirable health side affects when used in close proximity of a user's head or body. These side affects are allegedly caused by the high intensity of electromagnetic/radio frequency waves emitted by such host devices. It is therefore desirable to provide a cradle capable of accepting such host devices while protecting the user from such harmful emissions.

FEATURES OF THE INVENTION

A general feature of the present invention is the provision of an improved voice sound transmitting and receiving unit which overcomes the problems found in the prior art.

A further feature of the present invention is the provision of an improved voice sound transmitting and receiving unit which is capable of connecting to a host device.

Another feature of the present invention is the provision of an improved voice sound transmitting and receiving unit which includes a cradle for a host device.

A still further feature of the present invention is the provision of a voice sound transmitting and receiving device which protects the user from harmful emissions by the host device.

Another feature of the present invention is the provision of a voice sound transmitting and receiving unit that is capable of operatively connecting to a host device.

These, as well as other features and advantages of the present invention, will become apparent from the following specification and claims.

SUMMARY OF THE INVENTION

The voice sound transmitting unit of the present invention includes an earpiece that is adapted for insertion into the external auditory canal of the user, the earpiece having a sensor adapted to convert vibration of voice sound information into electrical signals. The voice sound transmitting and receiving unit also includes a transmitter through which the sensed electrical signals are sent to a cradle. The cradle portion of the present invention includes a receiver and a connector. The receiver is adapted to receive the signal from the transmitter. From the receiver, the electrical signal may be sent through the connector to the host device.

In a preferred form, the sensor in the earpiece of the present invention includes a bone conduction sensor adapted to convert bone vibrations of voice sound information into electrical signals and an air conduction sensor residing within the auditory canal of the user and converting air vibrations of voice sound information into electrical signals. It is to be understood that either the bone conduction sensor or the air conduction sensor may be used individually, however, it is felt the use of both sensors provides the purest voice sound signal. Additionally, a speech processor is present in the earpiece, the speech processor sampling output from the bone conduction sensor and the air conduction sensor. In comparing the sampled output, the speech processor is able to filter noise and select a pure voice sound signal for transmission. A transmitter accomplishes the task of transmission through the use of a wireless linkage. A wireless linkage is preferred though it is readily understood that a hard-wired linkage may be used. While a hard-wired linkage may adequately accomplish the task of transmission, such a linkage may also be cumbersome,

restrict the range of motion of the user, and be aesthetically unappealing.

Preferably, the earpiece also includes a receiver adapted to receive incoming signals of sound information from a cradle based transmitter. The incoming sound information is then heard by the user through a speaker located in the earpiece, the speaker being adapted to receive the incoming sound information from the receiver.

The cradle portion of the present invention preferably includes a receiver adapted to obtain incoming voice sound information signals sent by the transmitter in the earpiece. These received signals are then sent to a connector which is operatively linked to a host device. Any sound information coming from the host device may also pass through the connector and is sent to the earpiece via a transmitter located in the cradle. The cradle may also include additional antennae for either the host device or the earpiece. Further, the cradle may include a power source for the host device or to supplement the host device's own power source. Finally, the cradle preferably includes shielding which will protect the user from any harmful emissions by the host device. It should be understood that the present invention has wide-ranging applications, not specifically limited to the examples disclosed in this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of the voice sound transmitting and receiving unit and cradle of the present invention with a sample host device installed.

Figure 2 is a cross-sectional view of the voice sound transmitting and receiving unit of Figure 2 taken through the external auditory canal of the user.

Figure 3 is a perspective view of the cradle of the present invention.

Figure 4 is a side view of the cradle of the present invention taken along the section AA line of Figure 3.

Figure 5 is a top view of the cradle of the present invention.

Figure 6 is a front view of the cradle of the present invention.

Figure 7 is a block diagram of the main componentry of the voice sound transmitting unit of the present invention.

Figure 8 is a block diagram of the main componentry of an alternative embodiment of the voice sound transmitting unit of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will be described as it applies to its preferred embodiment. It is not intended that the present invention be limited to the described embodiment. It is intended that the invention cover all modifications and alternatives which may be included within the spirit and scope of the invention.

Now, referring to the drawings, Figure 1 shows the voice sound transmitting unit 10 of the present invention. The voice sound transmitting unit 10 includes an earpiece 12, which is operatively linked to a cradle 30, which contains a host device 32. The earpiece 12 preferably includes a bone conduction sensor, an air conduction sensor or microphone 16, and a speaker 24. However, it is to be understood that the use of both the air conduction sensor 16 and the bone conduction sensor 14 is not required, but merely allows the transmission of the purest voice sound signal. Either the bone conduction sensor 14 or the air conduction sensor 16 may be used as the sole means for sensing voice sound vibrations.

A casing 18 is also provided in the earpiece 12. The casing 18 has an ear attachment portion 20 and a fitting portion 22 that connects the ear attachment portion 20 with the bone conduction sensor 14 and the air conduction sensor 16. The ear attachment portion 20 is contoured to fit over and behind the upper ear lobe of the user and is preferably made of a lightweight aluminum or plastic material. It can be appreciated that the primary purpose of the ear attachment

portion 20 is to secure the earpiece 12 in proper position. The fitting portion 22 is integral with the ear attachment portion 20 and is reinforced with a flexible wire (not shown) so that the earpiece 12 may be adapted to fit the user and maintain the bone conduction sensor 14 and the air conduction sensor 16 in their proper positions within the external auditory canal 28 of the user. As is best shown in Figure 2, the voice sound transmitting unit 10 should fit so that the bone conduction sensor 14 is in operative contact with a portion of the external auditory canal 28. It is preferred that the bone conduction sensor 14 rest directly against the posterior superior wall of the external auditory canal 28, with the fitting portion 22 shaped to bias the bone conduction sensor 14 into position. Fitting the device and calibrations may be performed by the user or with the assistance of a physician or an audiologist/audiology technician.

The bone conduction sensor 14 is of standard construction and may be obtained from various hearing aid manufacturers, including Endevco and others. Note that the bone conduction sensor 14 may be of the acceleration type and utilize a piezoelectric pick-up. Other pick-ups that can be used with the present invention, include, but are not limited to, those of the magnetic type, electret condenser type, IC type and semi-conductor type. All are well known in the art.

The earpiece 12 is formed so that the bone conduction sensor 14 may be inserted into the external auditory canal 28 of the user and contact against the posterior superior wall 25 of the canal. The bone conduction sensor 14 is intended to pick up, as the voice signals, the vibrations of the upper wall of the external auditory canal 28 at the time of uttering the voice sounds. When the user utters voice sounds, these sounds reach the mastoid bones. These sound vibrations in the external auditory canal portion in contact with the bone sensor 14 are then processed.

In addition to the bone conduction sensor 14, the earpiece also includes an air conduction sensor or microphone

16. Like the bone conduction sensor 14, the air conduction sensor 16 is of standard construction and may be obtained from various manufacturers, such as ReSound and Oticon, both of which have numerous air microphones which would suffice. The bone conduction sensor 14 and the air conduction sensor 16 are both tuned to receive frequencies within the range of human speech, approximately from 50 to 8,000 Hertz. The earpiece also includes a speaker 24 and any necessary power supply to enable two-way communication.

A resilient member (not shown) is preferably positioned between the air conduction sensor 16 and the bone conduction sensor 14 in such a manner that the external sound collected by the air conduction sensor 16 will not be transmitted to the bone conduction sensor 14.

A circuit portion (not shown) transmits the electrical signals from both the bone conduction sensor 14 and the air conduction sensor 16 to a speech processor 26. A power source, such as a LiH or NiMH battery is operatively connected to the circuit portion. The power source (not shown) may be rechargeable. The speech processor 26 is of conventional construction used in many hearing aids and employs an analog or digital processing scheme to package the voice signal for transmission across a wireless linkage. In a preferred embodiment, the speech processor 26 will be programmed to compare similarities from the air and bone transmissions, extract the similarities in signals and then transmit the purest signal via a wireless linkage to the cradle 30. The speech processor 26 also filters out through band pass filters, sounds outside the frequency of normal human speech. This selected common voice signal increases the likelihood that ambient and environmental interference will be minimized.

As shown in Figure 8, the speech processor 26 then transmits the selected voice signal to a transmitter 48. The transmitter 48 of Figure 8 is preferably a wireless radio frequency transmitter well known in the art that includes a multi-directional antenna 52 (See Figure 1). Examples are

Proxim Corporation's Range Lan2 or Breezecom radio transmission systems. An infra-red transmitter, commonly known in the art, may alternatively be used.

As is shown in Figure 1, the cradle 30 contains a host device 32. As shown in greater detail in Figure 3, the cradle 30 is comprised of several components. The cradle 30 preferably includes a base 54 in which the connector 34 is secured. The base 54 is capable of supporting any host device in a proper position so as to ensure proper mating between the connector 34 and any connectors on the host device 32. The base 54 of the cradle 30 is attached to a plurality of surrounding walls 56. These surrounding walls 56 in conjunction with the base 54, form a cavity in which the host device 32 may rest. The surrounding walls 56 allow easy access to the front of the host device 32 and easy removal of the host device 32 through the top of the surrounding walls 56. A belt clip 46 may be attached to the outer side of the surround walls 56 to allow a user to wear the cradle 30. Additionally, any other type of clip or attachment device may be used as desired.

When the host device 32 is fit into the cradle 30, the external connectors of the host device 32 operatively engage and connect with the connector 34 of the cradle 30. The connector 34 is of conventional construction and may be of any size, shape or type to allow for easy connection, or mating, with the connectors on the host device 32. Connector 34 may be a parallel type connector, a serial connector, a headphone jack-type connector or any other type of connector which is currently known in the art. Connector 34 is operatively linked to a receiver 36. The receiver 36 is connected to one or more antennae 40.

As shown in Figure 7, signals from the transmitter 48 of the earpiece 12 are received via the antenna 40 in the receiver 36. Upon reception, any analog or digital or digital to analog conversions which are necessary may be performed. Further, if desired, additional processing may be performed to further refine the received voice sound signals.

These received voice sound signals are then sent through the connector 34 to the host device 32.

Additionally, the cradle 30 may include radio frequency or electromagnetic shielding 44 in the surrounding walls 56 and base 54 to properly protect the user from any harmful emissions from the host device 32. This shielding 44 may include a copper mesh or lead plate. As this shielding 44 may also inhibit the reception/transmission of signals to and from the host device 32, additional antennae 40 may be provided for use by the host device 32. Further, additional power may be required by a host device 32 and/or the cradle 30. Therefore, a removable and rechargeable LiH or NiMH battery 42 may be provided at the base of the cradle 30.

As shown in Figure 8, the connector 34 may also operatively link the host device 32 to a transmitter 38. Through the transmitter 38, the host device may send signals to a receiver 50 in the earpiece 12. The received signals would then be transmitted from the receiver 50 to a speaker 24. Of course, receivers and transmitters may be combined into a single, commonly available transceiver.

Figures 7 and 8 show in block diagram form the different components of the voice sound transmitting unit 10. Figure 7 shows the basic componentry for accomplishing the mere transmission of voice sound information from a sensor 13 of any type via a transmitter 48 to a receiver 36 operatively linked to a connector 34 which transmits the voice sound information to the host device 32.

Figure 8 shows the basic componentry for the voice sound transmitting unit 10 of the present invention adapted to enable two-way communication. As shown, the sensor 13 is operatively connected to a processor 26. The voice sound information received by the sensor 13 is processed in the processor 26 and transmitted via the transmitter 48 to a receiver 36 in the cradle 30. The receiver 36 then transmits the voice sound information to the connector 34 which is linked to the host device 32. Additionally, the host device 32 may receive incoming signals and send them through the

connector 34 to a transmitter 38 in the cradle 30. These incoming signals are then sent to a receiver 50 in the earpiece 12. If necessary, the incoming signals may be routed through the processor 26 in order to properly adjust them for use by the speaker 24. Optionally, the incoming signals may be sent directly from the receiver 50 to the speaker 24.

It can be appreciated that the voice sound transmitting unit 10 of the present invention can be used in conjunction with the multitude of host devices 32. Such host devices 32 may include, but are not limited to, cellular telephones, personal digital assistants, radios, CD players, or any type of computer equipment. Additionally, it is to be understood that the cradle 30 of the present invention may be of any desirable size and shape in order to properly accommodate the particular host device 32 with which the cradle 30 is to be used.

A general description of the present invention, as well as a preferred embodiment of the present invention, has been set forth above. Those skilled in the art to which the present invention pertains will recognize and be able to practice additional variations in the methods and systems described which fall within the teachings of this invention. Accordingly, all such modifications and additions are deemed to be within the scope of the invention which is to be limited only by the claims appended hereto.